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Non-battle craniomaxillofacial injuries from U.S. military operations

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ABSTRACT

Introduction: Non-battle injuries (NBIs) can be a source of significant resource utilization for the armed forces in a deployed setting. While the incidence and severity of craniomaxillofacial (CMF) battle injuries (BIs) have reportedly increased in the ongoing U.S. military conflicts in Iraq and Afghanistan, the prevalence and the nature of NBIs are not well described.

Material and methods: The Joint Theater Trauma Registry was queried from October 2001 to February 2011, covering Operations Enduring Freedom and Iraqi Freedom, for both NBIs and BIs to the CMF region. Patient demographics, injury severity score, mechanism and type of injury were included in the query. Using ICD-9 diagnosis codes, CMF injuries were classified according to type (wounds, fractures, burns, vascular injuries, and nerve injuries). Statistical analysis was performed for comparative analysis.

Results: NBIs constituted 24.3% of all patients with CMF injuries evacuated to a regional combat support hospital (CMF BIs 75.4%). These injuries were characterized by blunt trauma, most commonly motor vehicle collisions (37%), and falls (20%). As compared to CMF BIs, CMF NBIs resulted in less mortality (1.3% vs. 3.1%, $p < 0.0001$), fewer injuries per patient (1.87 vs. 2.26, $p = 0.055$), and a decreased severity score (ISS) (8.38 vs. 12.98, $p < 0.0001$). However, a significant percentage of CMF NBIs still required evacuation out of theater (27.8% of NBIs vs. 42.2% of BIs, $p < 0.0001$), depleting the combat strength of the deployed forces.

Conclusions: CMF NBIs accounted for a substantial portion of total CMF injuries. Though characterized predominantly by blunt trauma with an overall better prognosis, its burden to the limited resources of a deployment can be significant. This descriptive study highlights the need to allocate appropriate resources for treatment of these injuries as well as strategies to reduce both its incidence and severity.

Level of evidence: IV Prognostic

1. Introduction

Non-battle injuries (NBIs) can be a source of significant resource utilization for deployed armed forces. The increasingly technological environment of the battlefield has raised the proportion of deaths of NBIs among all deaths of US troops from 3% during the Civil War to 16% in World War II (Garfield and Neugut, 1991). In the Vietnam War, NBIs were the leading type of casualty (Blood and Jolly, 1995). During the Persian Gulf War (Operations Desert Shield and Desert Storm), NBIs accounted for a high percentage of deaths (46%) and hospital admissions (25%) (Withers et al., 1994; Writer et al., 2000; Eaton et al., 2011). Several studies have shown that most NBIs result from a variety of potentially preventable causes ranging from motor vehicle crashes, falls, physical training/sports, assault, and other accidents (Withers et al., 1994; Writer et al., 2000; Wade et al., 2007; Breeze et al., 2010).

We, amongst other investigators, have shown the incidence of craniomaxillofacial (CMF) battle injuries (BIs) have been increasing, with an incidence between 19 and 42% (Carey, 1987; Zouris et al., 2006; Wade et al., 2007; Lew et al., 2010; Chan et al., 2012; Zachar et al., 2013). The reason is that the CMF region is not adequately protected by contemporary armour technologies and is thus vulnerable on the battlefield. This is further enhanced by the evolving nature of modern combat where the primary mechanism of injury ranges from explosive devices (improvised explosive devices (IEDs), landmines, rocket propelled grenades (RPGs), mortars) to ballistic trauma (Shuker, 1995; Lew et al., 2010; Chan et al., 2012).

CMF NBIs sustained in the deployed setting and the role they play in the overall increasing incidence of wartime CMF injuries are

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not as well characterized. The object of this study is to provide a comprehensive overview of the CMF NBIs sustained during the 10-year period from 2001 to 2011, and to understand the incidence, nature and severity of these injuries. We have found CMF NBIs often result in less severe injuries than its BI counterpart, but they are prevalent, accounting for one-quarter of all CMF injuries. Based on our review of the available literature, this study represents the only series of CMF NBI representative of the past ten years of war in Iraq and Afghanistan.

2. Material and methods

A retrospective review was performed using the Joint Theater Trauma Registry (JTTR), a database of all US service members injured and treated in a military treatment facility since the beginning of the wars in Iraq and Afghanistan. The database was queried from October 2001 to April 2011 using the ICD-9 (Ninth Revision of the International statistical Classification of Diseases and related health problems) codes to identify CMF injuries, as previously described (Chan et al., 2012). NBIs were the primary focus of this study though the group of BI patients was used for comparison. Subjects who were Killed-In-Action were excluded as were those who returned to duty (discharged from medical care within 72 h after admission). All subjects identified as having a NBI to the CMF region requiring evacuation to a level III Combat Support Hospital (highest level of care within the combat zone) were included in the study. Isolated intracranial injuries, corneal abrasions, and tympanic membrane ruptures were excluded. Subject demographics including age, gender, branch of service, injury type, location, injury severity score (ISS), mechanism of injury and survival were tabulated.

The total number of injured subjects during the study period and the number transferred to escalating military levels of care were also obtained from the JTTR. This study was conducted under a protocol reviewed and approved by the US Army Medical Research and Materiel Command Institutional Review Board and in accordance with the approved protocol.

The study database was maintained under data encryption in Access (Microsoft Corp., Redmond, WA). Statistical analysis of all results was completed using chi-square test for all categorical data and paired *t*-test for continuous data. Cut off for significance was $p < 0.005$.

3. Results

The Department of Defense reported that 26,686 total service men and women were injured during the 10-year period from 2001 to 2011. Based on our query of the JTTR using ICD-9 codes, a total of 6740 patients were identified as having an injury to the CMF region who presented to a level III military hospital. NBIs accounted for 1643 (24.3%) of patients and BIs accounted for the remaining 5094 (75.4%). The NBI group had a slightly higher percentage of females 5.6%, as compared to 1.8% for BI ($p < 0.0001$). The total number of injuries (as defined by the number of distinct ICD-9 diagnosis codes) for the study group was 14,604, with an average of 1.87 injuries per patient for the NBI group and 2.26 for the BI group ($p = 0.055$). Moreover, the NBI group was found to have an overall lower ISS and mortality, 8.37 and 1.3% respectively, when compared to the BI group, 12.97 and 3.1% ($p < 0.0001$) (Table 1).

NBIs were characterized predominantly by blunt trauma, with mechanisms including motor vehicle collisions (MVCs) (37%), falls and other blunt trauma (both 20%). This is in sharp contrast to BIs, which are predominantly penetrating type injuries with mechanisms including explosives (including improvised explosive devices (IEDs) and rocket propelled grenades (RPGs)) (88%), ballistics (7%) and MVCs (2%). All injury mechanisms were statistically different between BI and NBI groups ($p < 0.0001$) (Fig. 1).

Table 1
Demographics of CMF battle and non-battle injuries presenting to a combat support hospital.

Demographic	CMF battle		CMF non-battle		*p*-Value
	Number	%	Number	%	
Total	5094	75.4	1643	24.3	
Sex					
Male	5002	98.2	1554	94.6	$p < 0.0001$
Female	92	1.8	89	5.6	
Military operation					
OIF	3780	74.2	1288	78.4	$p = 0.0006$
OEF	1314	25.8	355	21.6	
Military branch					
Air force	77	1.5	63	3.8	$p < 0.0001$
Army	3833	75.2	1250	76.1	
Navy	101	2.0	67	4.1	
Marines	1083	21.3	263	16.0	
Mortality	158	3.1	21	1.3	$p < 0.0001$

	CMF battle		CMF non-battle		*p*-Value
	Mean	SD	Mean	SD	
Age	25.85	6.23	26.44	7.03	$p < 0.0001$
Injury severity score	12.98	11.90	8.38	9.01	$p < 0.0001$

Percentages reported are relative to injury class. A total of 6760 patients were identified based on our query of the JTTR for ICD-9 codes of the CMF region. Data does not represent patients of unknown injury class which represented 0.34% of all CMF injured patients.

Among NBI patients presenting to a combat support hospital, 17.0% had a CMF injury, compared to 29.9% of all BI patients. This

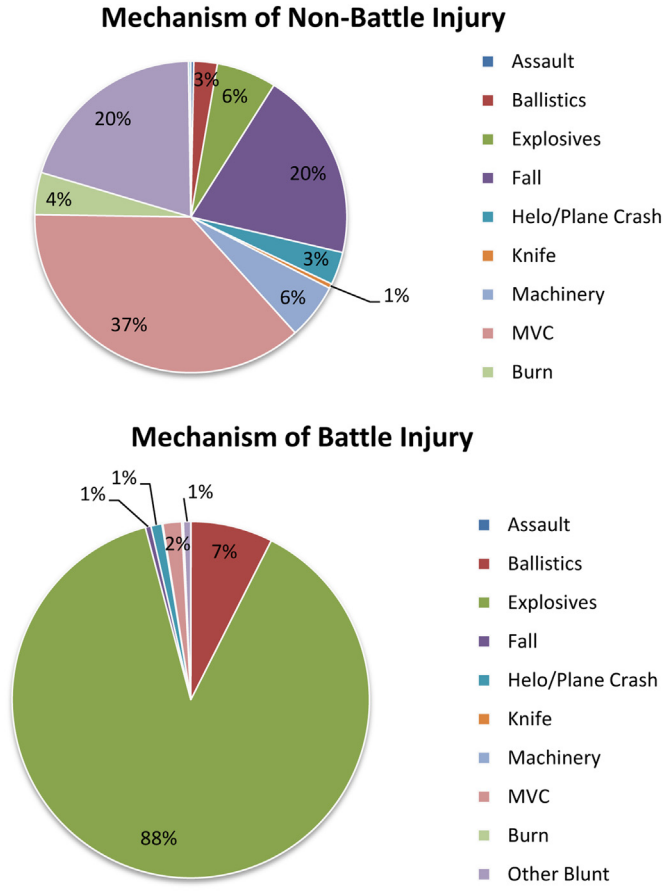

Fig. 1. Comparison of mechanism of injury by injury class.

increased to 27.8% and 42.2% respectively as the care escalated to a level IV military hospital (Regional referral hospitals, such as Landstuhl Regional Medical Center in Germany) and then to 24.7% and 37.5% respectively at a level V military hospital (Tertiary care hospitals in the continental U.S.) ($p < 0.0001$). A difference was noted in the relative percentage of CMF NBI vs. BIs that advanced to higher levels of care as well. Among CMF NBI patients, 56.3% advanced from level III to IV and 39.1% from level IV to V. The advancing proportion was higher in the CMF BI group, being 78.2% and 63.6% from level III to IV and IV to V respectively ($p < 0.0001$) (Table 2).

Based on ICD-9 diagnosis codes, CMF injuries were classified into five broad categories; open wounds, fractures, burns, nerve, and vessel injuries. The relative prevalence order of each injury type was the same between both the NBI and BI groups, with open wounds being the most common CMF injury (NBI 48.4%, BI 63.9%), followed by fractures (NBI 29.5%, BI 24.9%), burns (NBI 6.2%, BI 8.8%), nerve damage (NBI 3.0%, BI 5.7%), and vessel injury (NBI 1.5%, BI 5.4%). The relative percentage of each injury type was found to be statistically different between both groups ($p < 0.0001$) (Table 3).

In comparing the relative percentage of CMF BI and NBI between military operations OIF and OEF, there was a statistically significant lower percentage of injuries during the more recent OEF as compared to the earlier OIF (74.6% and 77.2% respectively, $p < 0.0001$) (Table 4).

Table 2
Breakdown of patients CMF ICD-9 codes with battle vs. non-battle injuries compared to total patients injured and at different echelons of care.

(a)

	Level					
	III		IV		V	
	Number	% CMF	Number	% CMF	Number	% CMF
Total injured	26,686	25.3	13,039	37.9	11,377	34.1
Battle	17,024	29.9	9530	42.2	8637	37.5
Non-battle	9662	17.0	3322	27.8	2603	24.7

(b)

	Level				
	III	IV		V	
	Number	Number	% Advanced	Number	% Advanced
Total CMF injured	6740	4945	73.4	3885	57.6
Battle	5094	4020	78.2	3242	63.6
Non-battle	1643	925	56.3	643	39.1

Percent CMF values listed are relative to total, battle, and non-battle classes at each echelon of care ($p < 0.0001$). Percent advanced values depict the proportion of CMF injuries that were escalated to that of care, relative to each injury class ($p < 0.0001$). Data does not represent patients of unknown injury class which represented 0.34% of all CMF injured patients.

Table 3
Injury distribution among CMF patients with battle and non-battle injuries.

Injury type	CMF battle		CMF non-battle	
	Number	%	Number	%
Open wounds	3254	63.9	795	48.4
Fractures	1266	24.9	484	29.5
Burns	446	8.8	102	6.2
Nerves	292	5.7	49	3.0
Vessels	275	5.4	24	1.5

Percentages based on total number of patients in each injury class, Battle = 5094, Non-battle = 1643; many patients having multiple injuries. $p < 0.0001$ for all groups comparing BI vs. NBI. <1% of each injury type was of an unknown injury class, data is not represented.

Table 4
Percentages of CMF battle injury and non-battle injury per military operation.

Operation	Total	CMF BI		CMF NBI	
		Number	%	Number	%
OIF	5068	3780	74.6	1288	25.4
OEF	1669	1314	77.2	355	21.3

Data does not represent unknown class patients with CMF injures ($n = 23$). $p = 0.0006$. Data does not represent patients of unknown injury class which represented 0.34% of all CMF injured patients.

4. Discussion

The ten years of conflict in Iraq and Afghanistan have resulted in countless deaths and even more wounded. While the majority of retrospective studies have rightly focused on battle causes, the relative attention paid to NBI is disproportionately less.

NBI probably results in a greater challenge from the standpoint of overall force readiness (Eaton et al., 2011). In this study, we have focused on NBI to the CMF region. While head and neck accounts for only 12% of the total body surface area, injury to this region results in a disproportionate amount of disability secondary to the critical senses served by the facial apparatus.

Historically, the overall rates of NBI were combined and recorded with rates of disease for specific military operations (Garfield and Neugut, 1991; Withers et al., 1994; Blood and Jolly, 1995; Writer et al., 2000). This made it difficult to draw conclusions as to the impact of NBIs on military resources, even more so to the subset of CMF NBIs. In this study, disease related admissions were not a part of study inclusion.

In this study, we found that NBIs account for one-quarter of all CMF injuries presenting to combat support hospitals. The remaining three-quarters are a result of BIs. NBIs are largely a result of blunt trauma, as opposed to BIs which are characteristically from explosive blasts. 28% of all subjects evacuated from theater due to NBI have CMF injuries, as compared to 42% of BI patients. CMF NBI patients are less critically injured with lower ISS, mortality and fewer injuries per patient. Moreover, they have a slightly lower rate of presentation and advancement to higher echelons of care for treatment of their injuries compared to BI patients.

Several differences in the demographics of the NBI group were observed. First, there were a statistically higher proportion of females with CMF NBIs. This is likely a result of the higher number of men injured in battle. Also there were proportionally fewer NBIs among U.S. marines. Again, this is consistent with the higher number of U.S. Marines involved in active combat.

Interestingly, there was a statistically significant lower percentage of CMF NBI during the more recent OEF as compared to the earlier OIF. The cause of this is not immediately evident and may require further investigation. However, we postulate that a proportion of NBI may be a result of unfamiliarity to a new environment (location and terrain, novel technologies, inexperienced troops, etc), and the later OEF have fewer of such incidents because of lessons learned from prior deployments (Table 4).

While not perhaps unexpected, one significant finding of our study is that NBIs had an overall lower mortality, fewer injuries per patient, and a better ISS when compared to the BIs. The generalization can thus be made that a NBI sustained in a deployed setting will most likely be less severe than a BI. Our evidence suggested that the reason for this difference may lie with the mechanism of injury. BIs were often caused by high energy insults predominantly from explosives and ballistics (Chan et al., 2012; Zachar et al., 2013). Explosive injuries, specifically those inflicted by IEDs, cause particularly severe injury patterns resulting in open wounds and

burns with underlying fractures (Goksel, 2005; Montgomery et al., 2005; Brennan, 2006; Salinas and Faulkner, 2010; Shuker, 2012; Zachar et al., 2013). This is in contrast to CMF NBIs, where lower energy mechanisms were found, mostly secondary to MVCs, falls and other blunt trauma. This mechanism of injury pattern more closely resembles that seen at rural civilian trauma centers (Ellis et al., 1985; Haug et al., 1990; Gassner et al., 2003; Allareddy et al., 2011; Smith et al., 2012).

Our study found the overall prevalence order of injury types to be the same within both the NBI and BI groups, with open wounds being the most common CMF injury followed by fractures, burns, nerve damage, and vessel injury. We also noted that, with the exception of CMF fractures, the percentage of each injury type was lower in the NBI group. Here again, the finding of CMF NBIs having overall fewer injuries per patient and a better ISS is supported (Table 3).

When analyzing the incidence of combat related injuries, it is important to consider whether data was limited by the echelons of care where services were rendered (Chan et al., 2012). Level I and II military treatment facilities are battalion aid stations and surgical company stations, respectively, used for triage and definitive treatment of minor injuries. Level III MTFs are combat support hospitals, and Level IV MTFs are regional referral hospitals such as Landstuhl Regional Medical Center in Germany. Finally, Level V hospitals are facilities in the continental United States where definitive care of the most serious injuries is rendered. The conclusion that NBIs tend to be less severe than BI is further supported when this data is evaluated. For instance, at level IV echelon of care, 27.8% of all NBI patients compared to 42.2% of all BI patients had CMF injuries. As one might expect, this trend is mirrored when evaluating what percentage of CMF NBI and BI were advanced from a lower to higher echelons of care. Because the CMF NBI was on average less severe in nature, definitive treatment of such injuries could more likely be rendered at lower level military hospitals.

While all the observations made in the comparisons between NBI and BI are perhaps not unexpected, the sheer numbers of NBI is what we find worthy of discussion. One out of every four CMF injured patients is a result of potentially preventable causes. It is paramount to determine whether these injuries are truly preventable and strategies implemented to prevent either its incidence or severity. In a limited review of cases presented to the military burn center, a high early rate of NBI burns were noted from a variety of preventable causes including waste burning, ammunition and gasoline handling. Feedback on NBI burn prevention was provided to the combat theater and the incidence of these injuries decreased (Kauvar et al., 2006). Many mechanisms leading to CMF NBI were potentially preventable causes and can be diminished through awareness and policy changes. Even though these injuries are less severe by all metrics than their BI counterpart (ISS, mortality, injuries/patient), more than half of them still required transport out of theater, depleting the active force and needed resources.

The military is undergoing a major systemic transformation to deal with the challenges of the 21st century modern warfare, using advances in technology and communication to improve operation efficiency. The use of smaller military units enhances the importance of each individual, meaning that reduced personal readiness may translate to a significant decrease in operational efficiency (Sanders et al., 2005). Despite advances in preventative measures, CMF NBIs are common and have a significant impact on military readiness and operational efficiency. Consequently, the adaptation of the military should include continued improvements in surveillance, prevention, and management of CMF NBIs.

5. Conclusion

The incidence and severity of CMF injuries have increased in modern combat. CMF NBIs accounted for a substantial portion of total CMF injuries. Though characterized predominantly by blunt trauma with an overall better prognosis, some of these injuries are potentially preventable and strategies to decrease both its incidence and severity are needed.

Author contribution

Andrew Q. Madson, DDS: Lead investigator, participated in all aspects of study.

David Tucker, DDS: Critical Revision.

Jay Aden, PhD: Statistical Analysis.

Robert G. Hale, DDS: Critical Revision.

Rodney K. Chan, MD, FACS: Participated in all aspects of study.

Conflict of interest

The authors of this paper have no conflicts of interest or undisclosed sources of funding. The opinions or assertions contained herein are the private views of the authors are not to be construed as official or as reflecting the views of the Department of the Army, Air Force or the Department of Defense.

References

Allareddy V, Allareddy V, Nalliah RP: Epidemiology of facial fracture injuries. J Oral Maxillofac Surg 69: 2613–2618, 2011

Blood CG, Jolly R: Comparisons of disease and non-battle injury incidence across various military operations. Mil Med 160: 258–263, 1995

Breeze J, Gibbons AJ, Opie NJ, Monaghan A: Maxillofacial injuries in military personnel treated at the Royal Centre for Defence Medicine June 2001 to December 2007. Br J Oral Maxillofac Surg 48: 613–616, 2010

Brennan J: Experience of first deployed otolaryngology team in Operation Iraqi Freedom: the changing face of combat injuries. Otolaryngol Head Neck Surg 134: 100–105, 2006

Carey ME: Learning from traditional combat mortality and morbidity data used in the evaluation of combat medical care. Mil Med 152(1): 6–13, 1987

Chan RK, Siller-Jackson A, Verrett AJ, Wu J, Hale RG: 10 years of war: a characterization of craniomaxillofacial injuries incurred during Operations Enduring Freedom (OEF) and Iraqi Freedom (OIF). J Trauma 73(6 Suppl. 5): S453–S458, 2012

Eaton M, Marshall SW, Fujimoto S, Gould PL, Poole C, Richarson DB: Review of non-battle injuries in Air Force personnel deployed in support of Operation Enduring Freedom and Operation Iraqi Freedom. Mil Med 176(9): 1007–1014, 2011

Ellis E, Moos KF, Al-Attar A: Ten years of mandibular fractures: an analysis of 2137 cases. Oral Surg Oral Med Oral Pathol 589: 120–125, 1985

Garfield RM, Neugut AL: Epidemiologic analysis of warfare. JAMA 266: 688–692, 1991

Gassner R, Tuli T, Hächl O, Rudisch A, Ulmer H: Cranio-maxillofacial trauma: a 10 year review of 9543 cases with 21,067 injuries. J Craniomaxillofac Surg 31: 51–61, 2003

Goksel T: Improvised explosive devices and the oral and maxillofacial surgeon. Oral Maxillofac Surg Clin North Am 17: 281–287, 2005

Haug RH, Prather J, Indresano A: An epidemiologic survey of facial fractures and concomitant injuries. J Oral Maxillofac Surg 48: 926–932, 1990

Kauvar DS, Cancio LC, Wolf SE, Wade CE, Holcomb JB: Comparison of combat and non-combat burns from ongoing U.S. military operations. J Surg Res 123: 195–200, 2006

Lew TA, Walker JA, Wenke JC, Blackbourne LH, Hale RG: Characterization of craniomaxillofacial battle injuries sustained by United States service members in the current conflicts of Iraq and Afghanistan. J Oral Maxillofac Surg 68(1): 3–7, 2010

Montgomery SP, Swiecki CW, Shriver CD: The evaluation of casualties from Operation Iraqi Freedom on return to the continental United States from March to June 2003. J Am Coll Surg 201: 7–13, 2005

Salinas NL, Faulkner JA: Facial trauma in Operation Iraqi Freedom casualties: an outcomes study of patients treated from April 2006 through October 2006. J Craniomaxillofac Surg 21: 967–970, 2010

Sanders JW, Putnam SD, Frankart C, Frenck RW, Monteville MR, Riddle MS, et al: Impact of illness and non-combat injury during Operations Iraqi Freedom and Enduring Freedom (Afghanistan). Am J Trop Med Hyg 73(4): 713–719, 2005

Shuker ST: Maxillofacial blast injuries. J Craniomaxillofac Surg 23(2): 91–98, 1995

Shuker ST: The immediate lifesaving management of maxillofacial, life-threatening haemorrhages due to IED and/or shrapnel injuries: "when hazard is in hesitation, not in the action.". J Craniomaxillofac Surg 40(6): 534–540, 2012

Smith H, Peek-Asa C, Nesheim D, Nish A, Normandin P, Sahr S: Etiology, diagnosis, and characteristics of facial fracture at a midwestern level I trauma center. J Trauma Nurs 19(1): 57–65, 2012

Wade AL, Dye JL, Mohrle CR, Galarneau MR: Head, face, and neck injuries during Operation Iraqi Freedom II: results from the US Navy-Marine Corps Combat Trauma Registry. J Trauma 63: 836–840, 2007

Withers BG, Erickson RL, Petruccelli BP, Hanson RK, Kadlec RP: Preventing disease and non-battle injury in deployed units. Mil Med 159(1): 39–43, 1994

Writer JV, DeFraites RF, Keep LW: Non-battle injury casualties during the Persian Gulf War and other deployments. Am J Prev Med 18(3 Suppl.): 64–70, 2000

Zachar MR, Labella C, Kittle CP, Baer PB, Hale RG, Chan RK: Characterization of mandibular fractures incurred from battle injuries in Iraq and Afghanistan from 2001–2010. J Oral Maxillofac Surg 71(4): 734–742, 2013 Apr

Zouris JM, Walker GJ, Dye J, Galarneau M: Wounding patterns for U.S. marines and sailors during Operation Iraqi Freedom, major combat phase. Mil Med 171(3): 246–252, 2006